

***SERVICE MANUAL***

**1930**  
**VGA COLOR MONITOR**

**AUGUST, 1990**

**PN-314255-01**

 **Commodore**

*Produced By:*

**Commodore International Spare Parts GmbH  
Braunschweig, West Germany**

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VGA COLOR MONITOR**

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***INTERNATIONAL EDITION***

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## IMPORTANT SAFETY NOTICE

Proper service and repair is important to the safe, reliable operation of all NAPCEC Equipment. The service procedures recommended by NAPCEC and described in this service manual are effective methods of performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

It is important to note that this manual contains various CAUTIONS and NOTICES which should be carefully read in order to minimize the risk of personal injury to service personnel. The possibility exists that improper service methods may damage the equipment. It also is important to understand that these CAUTIONS and NOTICES ARE NOT EXHAUSTIVE. NAPCEC could not possibly know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, NAPCEC has not undertaken any such broad evaluation. Accordingly, a servicer who uses a service procedure or tool which is not recommended by NAPCEC must first satisfy himself thoroughly that neither his safety nor the safe operation of the equipment will be jeopardized by the service method selected.

## WARNING

Critical components having special safety characteristics are identified with an S by the Ref. No. in the parts list and enclosed within a broken line\* along with the safety symbol  on the schematics or exploded views.

Use of substitute replacement parts which do not have the same specified safety characteristics may create shock, fire, or other hazards.

Under no circumstances should the original design be modified or altered without written permission from the N.A.P. Consumer Electronics Corp. NAPCEC assumes no liability, express or implied, arising out of any unauthorized modification of design. Servicer assumes all liability.

\*Broken line: 

## TABLE OF CONTENTS

TITLE	PAGE
SAFETY PRECAUTIONS .....	1
GENERAL .....	1
SPECIFICATIONS .....	2
CONTROLS .....	2
MECHANICAL REPLACEMENT PARTS LIST .....	3
CUSTOMER ADJUSTMENTS .....	3
ADJUSTMENT PROCEDURES .....	5
INTERCONNECT WIRING DIAGRAM (EXPLODED VIEW) .....	8
SCHEMATIC NOTES .....	9
CHASSIS REMOVAL .....	9
WAVEFORMS .....	10
SCHEMATIC DIAGRAM (MAIN & CRT SOCKET PANELS) .....	10
SCHEMATIC DIAGRAM (POWER SUPPLY) .....	11
P.C. BOARD (MAIN PANEL) .....	12
P.C. BOARD (CRT SOCKET PANEL) .....	13
P.C. BOARD (POWER SUPPLY PANEL) .....	14
REPLACEMENT PARTS LIST .....	15
SAFETY GUIDELINES .....	21
SCHEMATIC DIAGRAM (1930-B — CBM CASE COLOR MONITOR) .....	23

**SAFETY NOTICE**

ANY PERSON ATTEMPTING TO SERVICE THIS CHASSIS MUST FAMILIARIZE HIMSELF WITH THE CHASSIS AND BE AWARE OF THE NECESSARY SAFETY PRECAUTIONS TO BE USED WHEN SERVICING ELECTRONIC EQUIPMENT CONTAINING HIGH VOLTAGES.

**CAUTION**

USE A SEPARATE ISOLATION TRANSFORMER FOR THIS UNIT WHEN SERVICING.

## SAFETY PRECAUTIONS

### Picture Tube Replacement

The primary source of X-radiation in this monitor is the picture tube. The picture tube utilized in this chassis is specially constructed to limit X-radiation emissions. For continued X-radiation protection, the replacement tube must be the same type as the original, including suffix letter, or N.A.P. Consumer Electronics corp. (NAPCEC) approved type.

Safety goggles must be worn when the picture tube is replaced.

### Parts Replacement

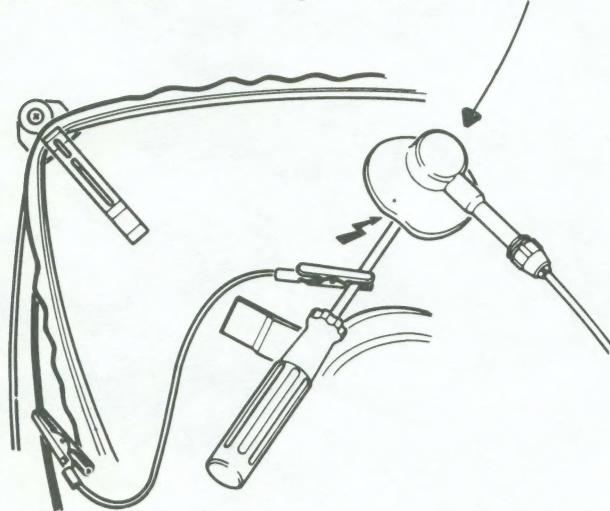
Many electrical and mechanical parts in NAPCEC monitors have special safety-related characteristics. These characteristics are often not evident from visual inspection nor can the protection afforded by them necessarily be obtained by using replacement components rated for higher voltage, wattage, etc. The use of a substitute part which does not have the same safety characteristics as the NAPCEC recommended replacement parts shown in this service manual may create shock, fire or other hazards.

## GENERAL



All ICs and many other semi-conductors are susceptible to electrostatic discharges (ESD). Careless handling during repair can reduce life drastically. When repairing, make sure that you are connected to the same potential as the mass of the set via a wrist wrap with resistance. Keep components and tools also at this potential.

To prevent ICs and transistors from being damaged, highvoltage flash-overs should be avoided. For checking the high voltage, a suitable meter should be used. The picture tube should be discharged only as indicated.



Be careful when measuring the EHT-section and the picture tube.

Use plastic instead of metal tools for adjusting. This is necessary to avoid a short-circuit or to avoid causing a circuit to become unstable.

Never replace components when the set is switched on.

### Removing the chassis

- Remove the backcover
- Slide out the chassis
- After repair the connecting cables of the chassis should be fixed in the original way.

## SPECIFICATIONS

(subject to modification)

AC voltage – 120Vac +/- 10% – 60Hz  
 Power consumption at 120V – 85 Watts  
 EHT – 24 KV  
 Line frequency – 31480 Hz  
 Frame frequency – 60 Hz/70 Hz  
 Band width – 18 MHz  
 Picture tube (9CM082) – M34 JPS 77 X 69  
 Picture tube (9CM062) – M34 JPM 70X69

**RESOLUTION**

Sync. polarity	– pos/neg
HOR. VERT.	
Pos. Neg.	– 640 dots X 350 lines
Neg. Pos.	– 640 dots X 400 lines
Neg.	– 640 dots X 480 lines

**INPUT SPECS**

RGB linear	– all colors
Sync TTL level	– pos/neg

**CONTROLS**

Front	: Power on/off SK1 (incl. LED indicator)
	: Brightness (R558)
	: Contrast (R322)
	: Horizontal phase (centering) (R408)
	: Vertical centering (R524)
Rear	: Horizontal width (R541)
	: Vertical height (R513 for 480 lines)

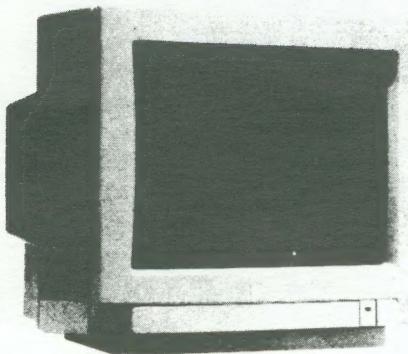
**INPUT SIGNAL CONNECTOR**  
 15 PIN "D" SHELL CONNECTOR

1 – red	6 – red ground	11 – ground
2 – green	7 – green ground	12 – n.c.
3 – blue	8 – blue ground	13 – horizontal sync
4 – n.c.	9 – n.c.	14 – vertical sync
5 – self test	10 – ground	15 – n.c.

**VGA STANDARD**

Horizontal frequency	Vertical frequency	H. Sync. polarity	V. Sync. polarity	Resolution (horizontal lines)
31.5 kHz	70 kHz	Positive (+)	Negative (-)	350
31.5 kHz	70 kHz	Negative (-)	Positive (+)	400
31.5 kHz	60 kHz	Negative (-)	Negative (-)	480

## MECHANICAL/ELECTRICAL PARTS

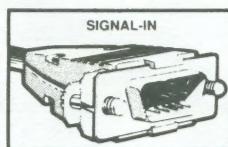


Ref.	Description	Part. No.
	Front Cabinet	1492150171
	Rear Cabinet	1492160058
	Push Button On/Off	1494200366
	Cover for Controls	1491320305
	Pad (Table Protectors)	4495200003
	Lock for Cover	1491410003
	Adjust Rod	1191000039
	Slider Chassis	1493030033
	Pedestal	1491080019
	Holder Line Input Transformer	1491070126
S	Mains Cord	4692020069
S	Picture Tube (9CM082)	M34JPS77X69
S	Picture Tube (9CM062)	M34JPM70X69
	Customer Inst. Book (9CM082)	IB53790001
	Customer Inst. Book (9CM062)	IB55180001
	Foot Pedestal (9CM082)	1491080019
	Foot Pedestal (9CM062)	1491030024
	Degaussing Coil	3691300012

## CUSTOMER ADJUSTMENT

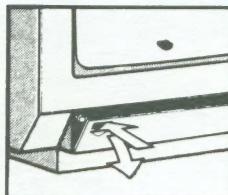
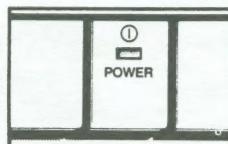
## 1. Connection

Connecting the monitor to the computer. The monitor is fitted with a 15-pin D-shell connector.



## 2. Adjustments and controls

a. Power on/off switch SK 1 (LED lights up)



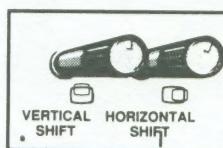
b. Contrast can be adjusted with control (R322)

c. Brightness can be adjusted with control (R558)



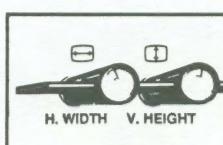
d. The image may be positioned horizontally with control (R408)

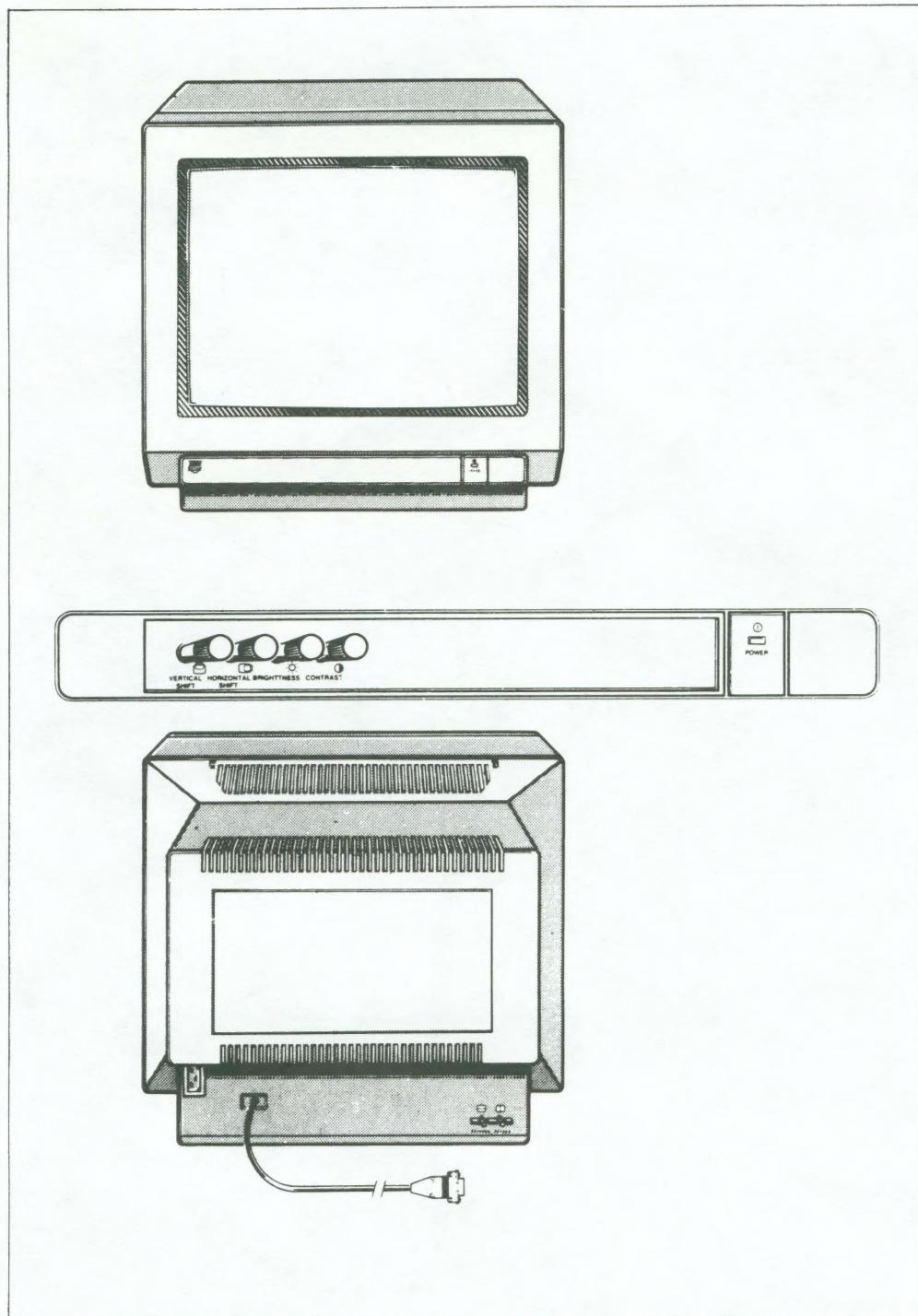
e. The image may be positioned vertically with control (R524)



f. You can adjust the image height with control (R513 for 480 lines)

g. The image width can be adjusted with control (R541)





## SERVICE ADJUSTMENTS

### Adjustment notes:

#### Caution

1. Use an isolation transformer when applying power to the exposed chassis.
2. Line voltage maintained at 120V AC, 60Hz.
3. The unit should be allowed to warm up for at least 30 minutes prior to making any adjustments.
4. Voltages measured with respect to ground.

#### Adjustments

##### 1. +120 Vdc supply voltage

- Contrast and brightness to minimum.
- Connect a voltmeter across C145 and turn on the monitor.
- Adjust R114 for a reading of 120V on the meter.

##### 2. Synchronization

###### Horizontal synchronization

- Inject a cross-hatch pattern and short R413/C415.
- Adjust R419 until the picture is straight.
- Remove the short-circuit

###### Vertical synchronization

- Turn off the vertical sync. by removing input signal.
- Adjust R504 for 47 Hz at pin 3 of IC501

##### 3. Focus

Adjust the focus control for optimal focus.

##### 4. Adjustment of picture geometry

- Inject a cross-hatch pattern and set brightness and contrast to the mechanical mid-position.

###### East-West correction

- Adjust R539 so that the vertical lines at the left-hand and the right-hand side are straight (480 lines).

###### Vertical linearity

- Adjust R516 so that a good linearity is obtained between upper and lower side of the picture (480 lines).

###### Horizontal amplitude

- Set the horizontal width to 240 mm with R541 (480 lines).

###### Horizontal position

- The horizontal centering can be adjusted with R441.
- Adjust R411 so that R408 allows as much shifting to the left as to the right (480 lines).

###### Vertical amplitude

- Adjust the vertical height to 180 mm with R513 (480 lines) (R507 for 400 lines and R509 for 350 lines).
- The vertical centering can be adjusted with R524.

###### Brightness presetting

- Set brightness to mechanical mid-position.
- Adjust R567 so that the voltage across C555 is -41V

##### 5. VG2 adjustment and cut-off points in picture tube

- Adjust brightness to mechanical mid-position and adjust contrast to maximum.
- Adjust VG2 (SCREEN) to minimum.
- Adjust R726, R733 and R739 to mechanical mid-position.
- Inject a white pattern signal and adjust VG2 (SCREEN) until one color becomes visible.
- Set the pattern generator to purity with the color that was first visible.
- Readjust VG2 to just visible light.
- Adjust the 2 remaining colors with their corresponding purity color for the same light output using potentiometers R726, R733 or R739.
- Now return to white pattern signal and adjust potentiometers R726, R733 and R739 until an optimum background color is formed.
- Using potentiometers R328, R332 and R335 (with white pattern signal), adjust the background color so that at minimum brightness and maximum brightness the background color is the same.

## SERVICE ADJUSTMENTS (Continued)

Note: The following adjustments need only be performed if the CRT has been replaced. Minor corrections for purity and convergence may be accomplished through the use of the Purity and Convergence Assembly located on the neck of the CRT.

## Color Purity adjustment (Refer to Figure 1)

1. Loosen the yoke clamp screw and slide the yoke back away from the rubber wedges.
2. Remove the rubber wedges (G) and slide the yoke forward until it rests firmly against the bell of the CRT.
3. Tighten the yoke clamp screw slightly so that the yoke can still be moved with some friction.
4. Place the multi-pole Purity and Convergence Assembly in the position shown in Figure 1.
5. Tighten screw (A) and turn securing ring (B) counterclockwise. Position the unit so that it faces in an East/West direction and degauss the instrument.

6. Turn on the power and inject a cross-hatch pattern signal. Allow a 10 minute warm-up period.
7. Roughly adjust the static convergence, using tabs C and D.
8. Set the Vertical Centering Control (R524) to its mechanical center. Disconnect R728 and R735 to turn off the green and blue guns.
9. Adjust the Two-pole purity rings (E) to center the red vertical and horizontal lines.
10. Inject a white pattern signal and move the deflection yoke to obtain a full red raster.
11. Turn on the green and blue guns by reconnecting R728 and R735. If a uniformly white raster does not appear, minor adjustments may be made by adjusting the purity rings (E).
12. Inject a cross-hatch pattern signal to ensure that the yoke is not tilted. If necessary rotate the yoke to obtain a level raster.
13. Tighten screw F and adjust R524 for proper vertical centering. Proceed to the Static Convergence Adjustment.

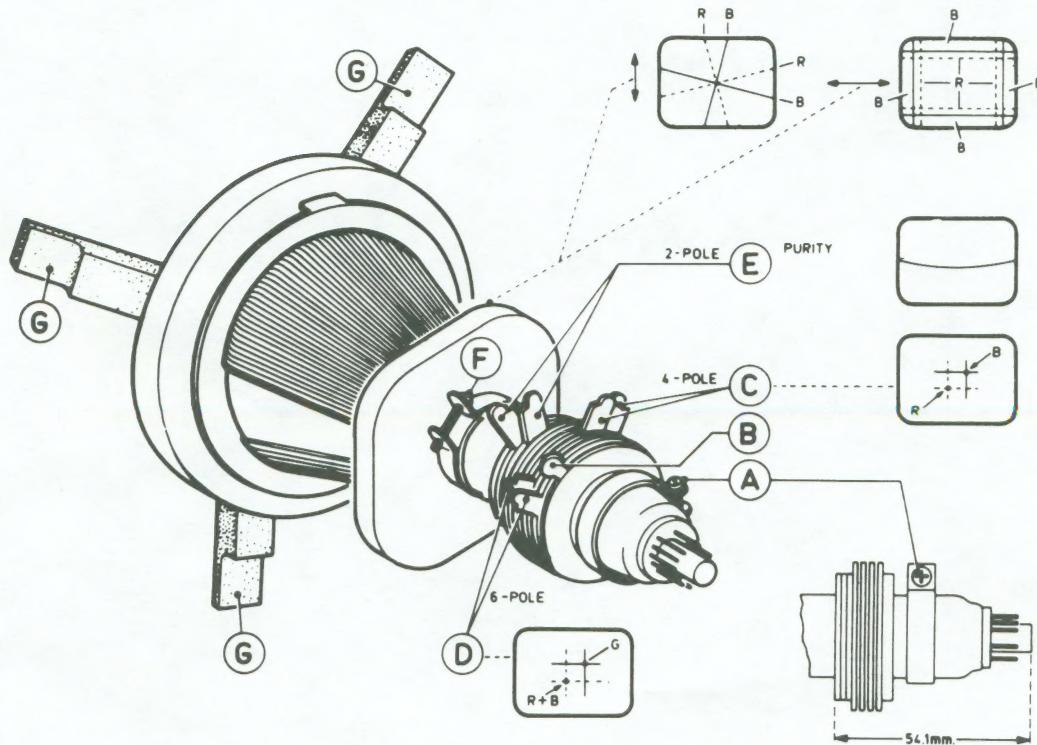


Fig. 1

## SERVICE ADJUSTMENTS (Continued)

## Static Convergence Adjustment

1. Inject a cross-hatch pattern signal and allow a 10 minute warm-up period.
2. Turn off the green gun by disconnecting R728. Turn locking ring (B) counterclockwise.
3. Slowly spread, and if necessary, rotate the 4-pole magnetic rings (C) to converge red and blue lines at the center of the screen.
4. Reconnect R728 to turn on the green gun and disconnect R735 to turn off the blue gun.
5. Slowly spread, and if necessary, rotate the 6-pole magnetic rings (D) to converge the red and green lines at the center of the screen.
6. Reconnect R735 to turn on the blue gun.
7. For optimum performance, repeat steps 1 through 6. Proceed to the Dynamic Convergence Adjustment.

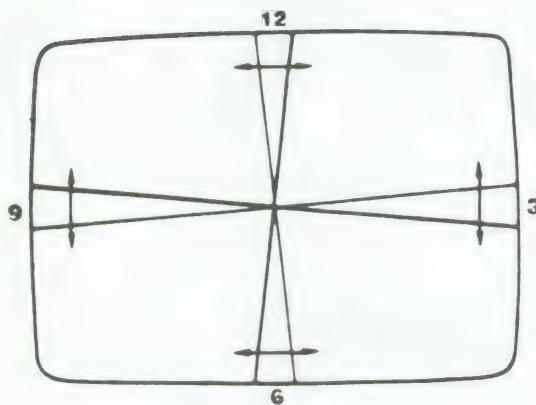


Figure 2 - Tilt yoke up or down to converge Red and Blue vertical lines at 6 and 12 o'clock positions, and Red and Blue horizontal lines at 3 and 9 o'clock positions.

## Dynamic Convergence Adjustment

1. Inject a cross-hatch pattern signal and turn off the green gun by disconnecting R728.
2. Tilt the yoke up and down to achieve the best convergence of the red and blue vertical lines at the 6 and 12 o'clock and the red and blue horizontal lines at the 3 and 9 o'clock positions (see Figure 2).
3. When the correct position has been found, place a rubber wedge between the yoke and CRT. If the yoke is tilted up, place wedge 1 as shown in Figure 3a; if it is tilted down, place wedge 1 as shown in Figure 4a.
4. Tilt the yoke to the left and right to find the point of best possible convergence of the red and blue lines at the edges, top, and bottom of the screen as shown in Figure 5.
5. When the correct position is located, place wedges 2 and 3 as shown in Figure 3b or 4b.
6. Remove wedge 1 and place it in the final position as shown in Figure 3c or 4c. Reconnect resistor R728 to turn on the green gun.



Figure 3a

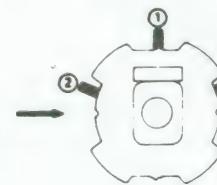


Figure 3b



Figure 3c

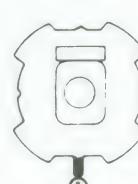


Figure 4a

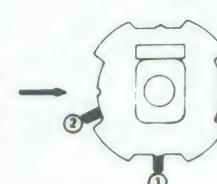


Figure 4b

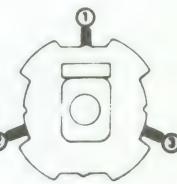


Figure 4c

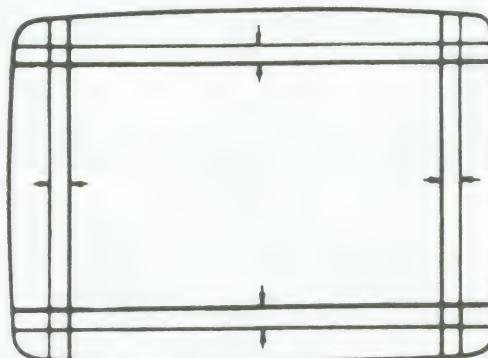
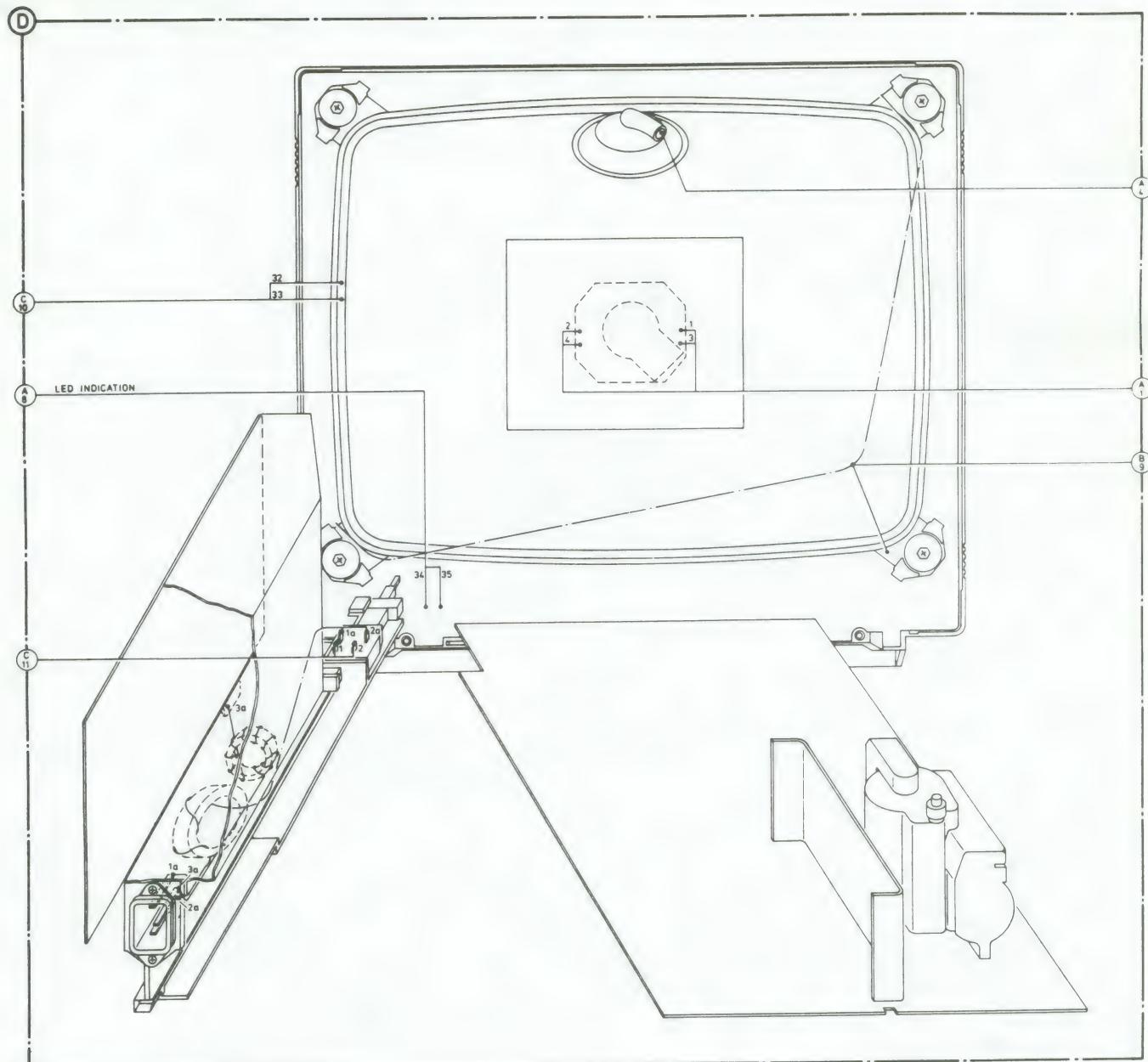


Figure 5 - Tilt yoke left to right to converge Red and Blue horizontal lines at the 6 and 12 positions, and Red and Blue vertical lines at 3 and 9 o'clock positions.

## INTERCONNECT WIRING DIAGRAM



## SCHEMATIC NOTES

1. DC voltages and waveforms should be measured with respect to ground as close as possible to the point to be measured.
2. All voltages are positive DC with respect to ground, be it the isolated ground (ground  ) or the AC ground (ground  ) and may vary due to normal production tolerances. Voltage sources are also nominal, with the exception of the 120Vdc source which is set at the factory to be +/- 1Vdc.
3. DC voltages and waveforms without brackets were measured under the following conditions:
  - A. Line voltage maintained at 120 Vac, 60Hz via an isolation transformer.
  - B. Contrast and brightness set at the mechanical mid-position (detent).
  - C. Using a color bar pattern from an RGB pattern generator (Network Technologies incorporated Montest-A5D3 or equivalent). On a scan format of 31.5kHz./480 line resolution.
4. DC voltages with brackets and waveforms with the suffix ( A ) and in a box were taken in the self test mode and in the same conditions as in steps 3A and 3B.
5. For voltage, wattage or tolerance ratings of capacitors or resistors, refer to the electrical replacement parts list.
6. The CRT board is provided with printed spark gaps. Each spark gap is arranged between an electrode of the CRT and the aquadag coating.
7. During manufacture alternative semiconductors may be used. However the semiconductors specified in the parts list and circuit diagram can always be used as replacements.
8. Capacitance values are listed in microfarads ( $\mu$ ), nanofarads (n) and picofarads (p).  $(0.001\mu=1\mu=1000p)$
9. \* = indicates component raised 1/4 inch above the P.C. Board.

## CHASSIS REMOVAL

With the back removed, all power disconnected and looking from the back.

1. Remove the bottom left CRT Screw with the Ground wire.
2. Remove the screw at the top of the Power Supply Panel with the ground wire.
3. Remove the screw above the AC power input plug.
4. Remove all cable and wire tie downs.
5. Unplug M102 and M110 from the Main Chassis.

6. Turn the back to the left. Start at the AC input plug and look to the right. Remove the first screw in the support bracket.
7. Now lift and pull the Main Chassis and the Power supply to the rear. Lay the Power supply to the left.
8. Remove the chassis rails and replug M102 to the Main Chassis.

To replace the the Main Chassis and Power Supply do the steps in reverse order.

**CAUTION**  
**USE A SEPARATE ISOLATION TRANSFORMER FOR THIS UNIT WHEN SERVICING.**

## WARNING

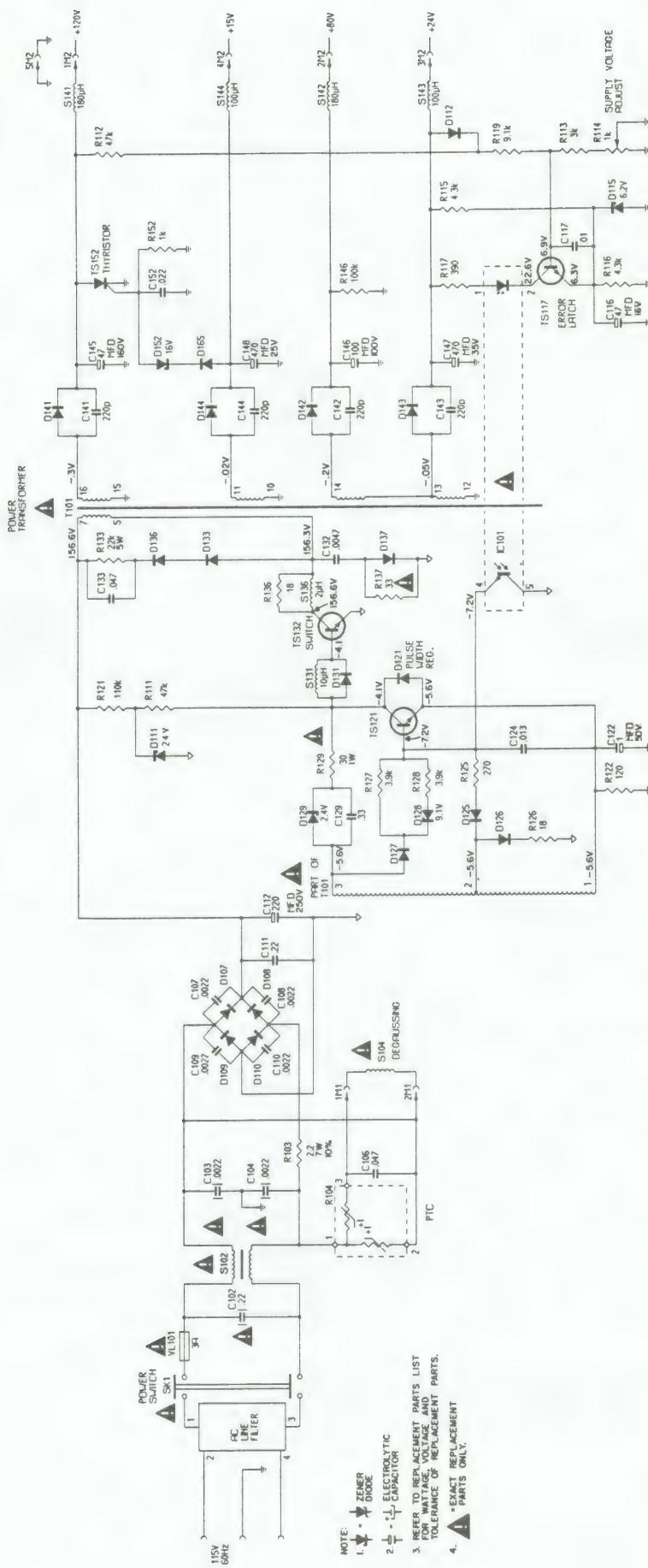
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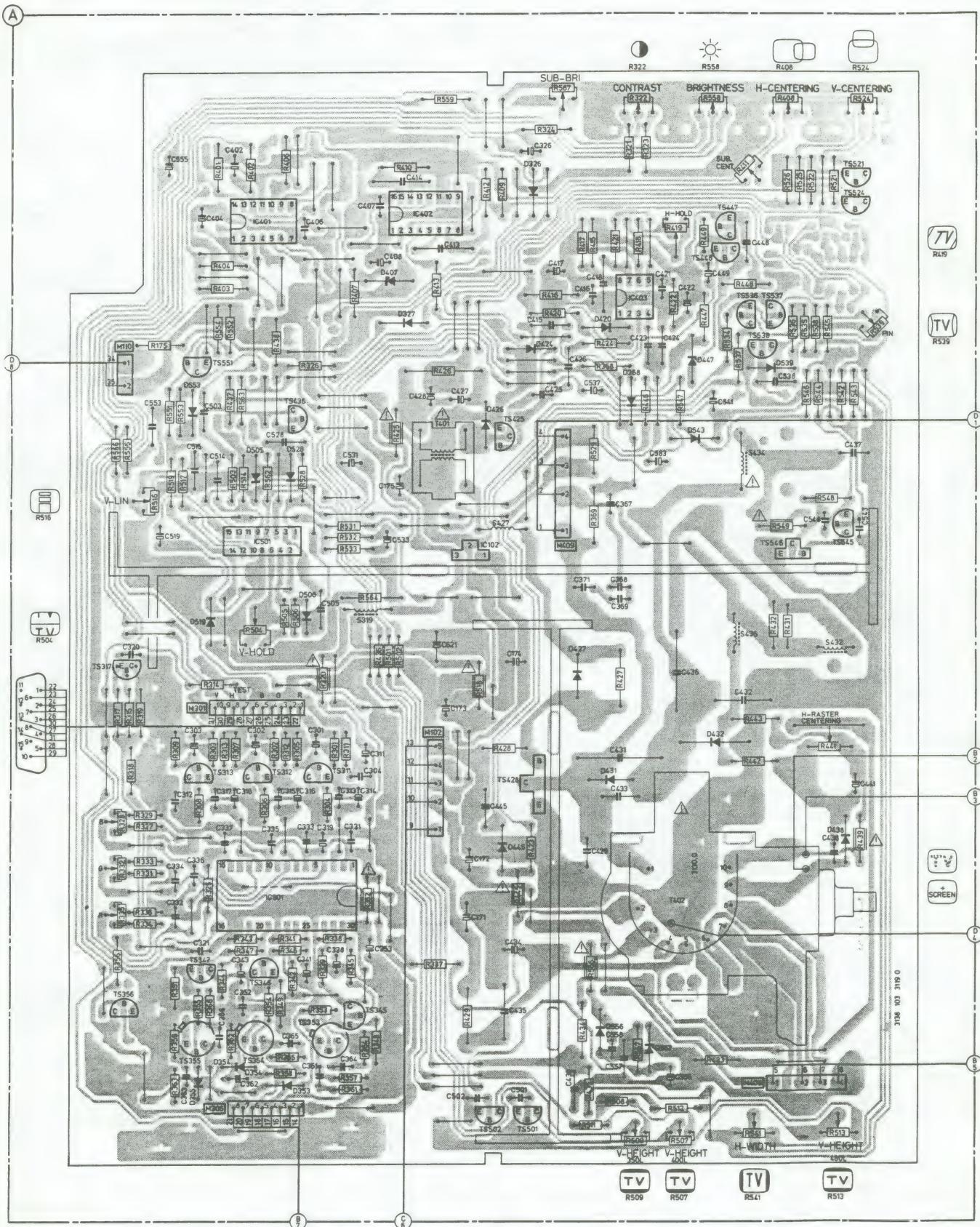
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\*Broken line: 

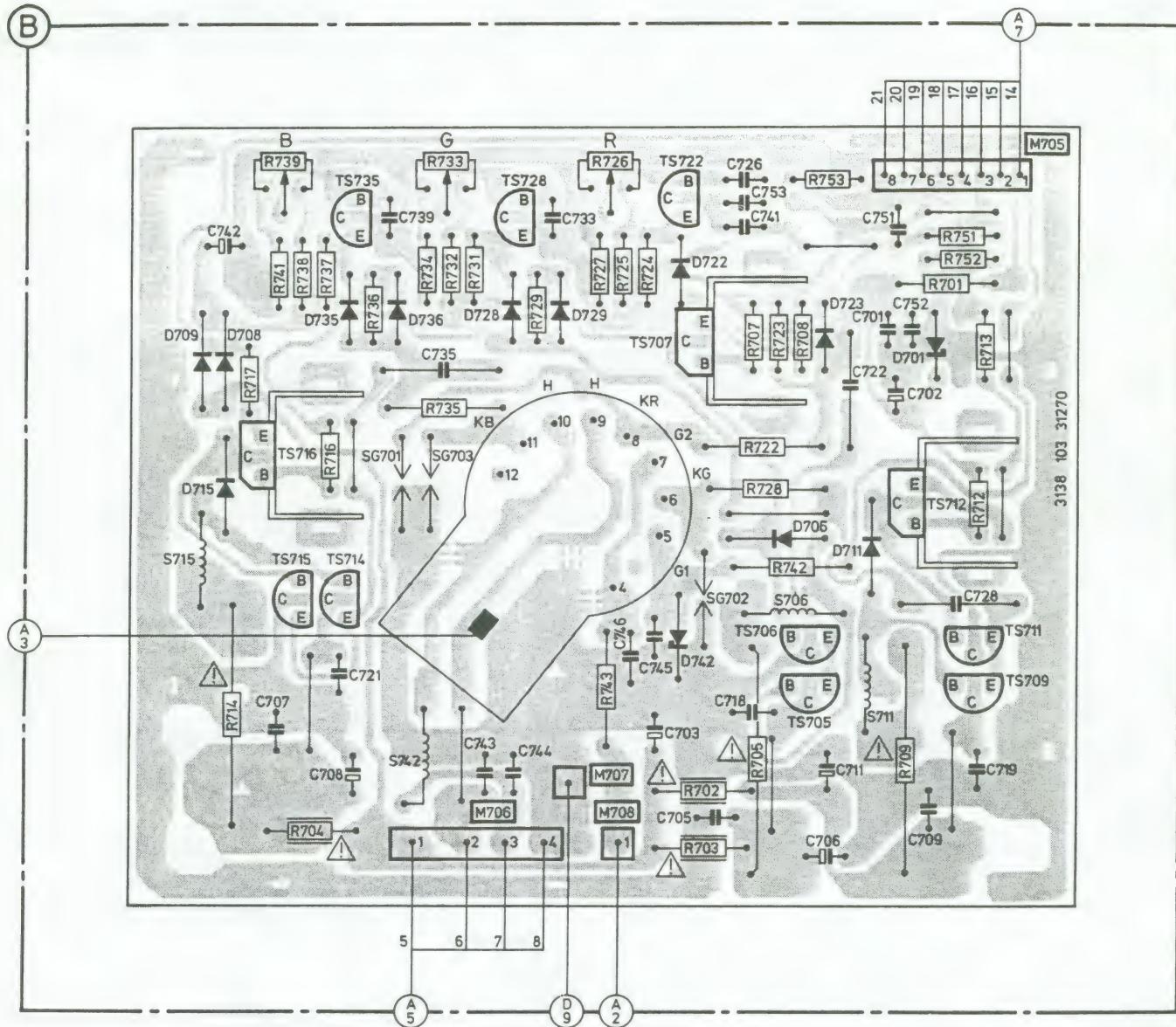
## POWER SUPPLY SCHEMATIC DIAGRAM



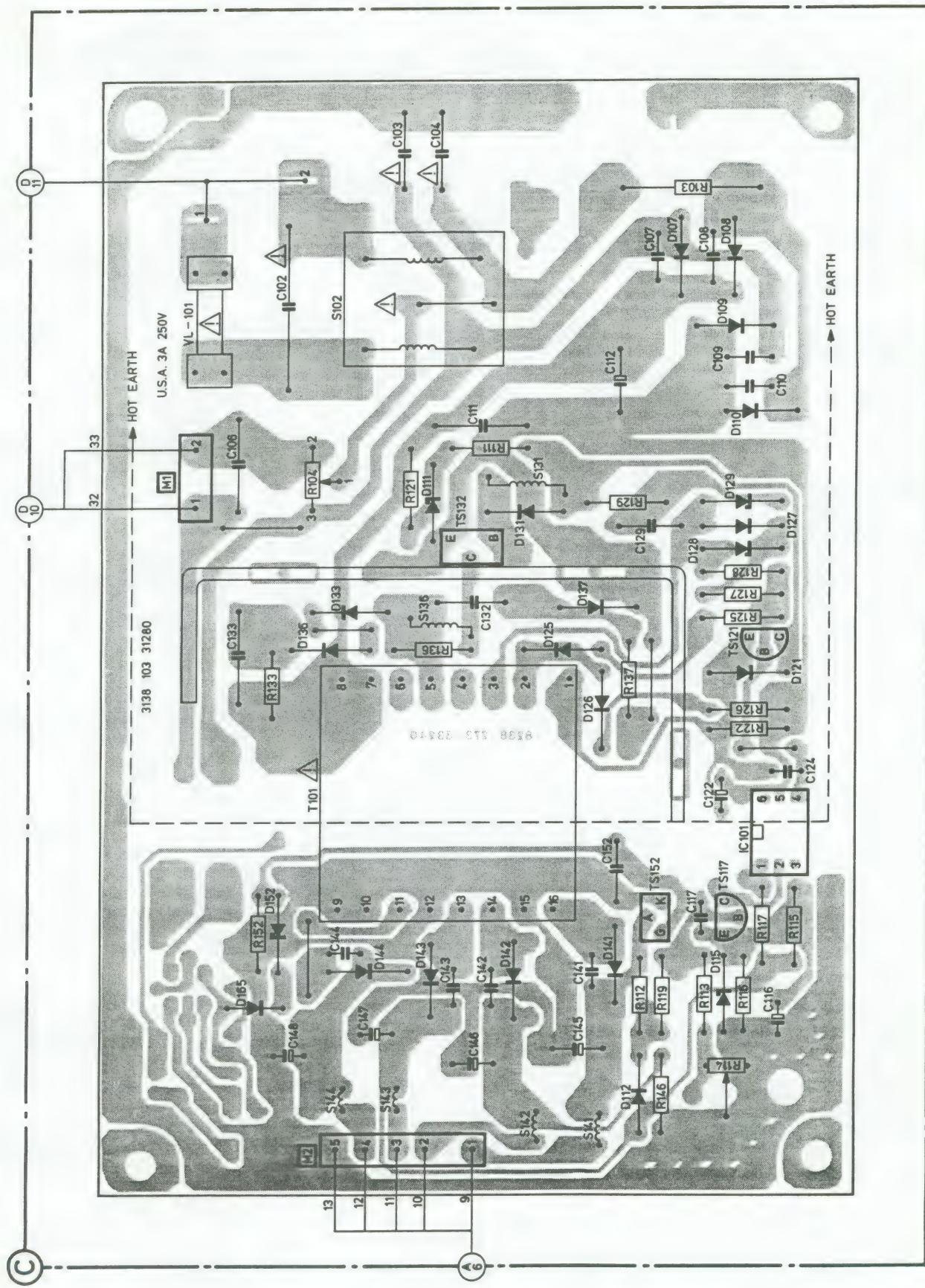
## MAIN P.C. BOARD (viewed from the component side)



## PICTURE TUBE P.C. BOARD (viewed from the component side)



## POWER SUPPLY P.C. BOARD (viewed from the component side)



## 9CM062/9CM082 REPLACEMENT PARTS LIST

To ensure optimum performance and reliability always use  
genuine factory replacement parts.

## PART OF LED ASSY

Ref.	Description	Part. No.
D175	Connector 2 pole LED green	4613990296 5392100470

C371 5.1pF, 10%, 500V, ceramic 2509041403

C402 10µF, 16V, electrolytic 2701741028

C404 10µF, 16V, electrolytic 2701741028

C406 0.010µF, 10%, 50V, ceramic 2508331038

C407 0.022µF, 20%, 50V, ceramic 2508332238

C408 100µF, 16V, electrolytic 2701741029

C413 0.0027µF, 10%, 50V, polyester 2509041381

C414 0.0027µF, 10%, 50V, polyester 2509041381

C415 0.010µF, 10%, 100V, polyester 2509041054

C416 0.010µF, 10%, 50V, ceramic 2508331038

C417 100µF, 16V, electrolytic 2701741029

C418 0.0033µF, 5%, 50V, polyester 2602320842

C421 0.0047µF, 20%, 50V, ceramic 2508304728

C422 1µF, 50V, electrolytic 2701741015

C423 0.1µF, 10%, 100V, polyester 2508141049

C424 0.010µF, 20%, 400V, polyester 2509581039

C425 27pF, 5%, 500V, ceramic 2509040814

C426 0.22µF, 10%, 100V, polyester 2508142249

C427 2.2µF, 63V, electrolytic 2791202297

C428 22µF, 35V, electrolytic 2701741099

C429 100pF, 10%, 2KV, ceramic 2509041404

C431 0.0039µF, 5%, 1.6KV, polyester 2602320837

C432 0.013µF, 5%, 400V, polyester 2509040290

C433 220pF, 10%, 2KV, ceramic 2602320844

C434 10µF, 160V, electrolytic 2796331000

C435 0.22µF, 10%, 250V, polyester 2602320543

C436 0.56µF, 10%, 250V, polyester 2596135649

C437 6.8µF, 50V, bi-polar 2701741027

C438 470pF, 10%, 500V, ceramic 2602320845

C439 0.047µF, 10%, 250V, polyester 2508154739

C441 220µF, 16V, electrolytic 2701741017

C445 0.010µF, 20%, 400V, polyester 2509581039

C448 0.047µF, 10%, 250V, polyester 2508154739

C449 1µF, 50V, electrolytic 2701741015

C501 0.001µF, 10%, 50V, ceramic 2508281029

C502 0.001µF, 10%, 50V, ceramic 2508281029

C503 0.010µF, 10%, 100V, polyester 2509041054

C505 0.33µF, 10%, 63V, polyester 2508143349

C514 0.10µF, 10%, 100V, polyester 2508141049

C515 0.10µF, 10%, 100V, polyester 2508141049

C519 220µF, 35V, electrolytic 2602320854

C521 1000µF, 35V, electrolytic 2701741022

C528 0.22µF, 10%, 100V, polyester 2508142249

C531 2200µF, 16V, electrolytic 2701741030

C533 47µF, 16V, electrolytic 2701741016

C537 100µF, 16V, electrolytic 2701741029

C538 0.33µF, 10%, 63V, polyester 2508143349

C541 100µF, 35V, electrolytic 2509041326

C543 0.0033µF, 10%, 50V, ceramic 2602320850

C548 100pF, 10%, 50V, ceramic 2508311019

C553 0.22µF, 10%, 100V, polyester 2508142249

C555 1µF, 160V, electrolytic 2701741021

C556 10µF, 160V, electrolytic 2796331000

C557 0.1µF, 20%, 250V, polyester 2508881049

C558 470pF, 10%, 500V, ceramic 2602320845

PARTS OF CHASSIS  
MISCELLANEOUS

Ref.	Description	Part. No.
	micro connector 2 pole	1813930150
	micro connector 8 pole	1814521282
	socket 5 pole	1814521053
	micro connector 10 pole	1814521446
	connector 4 pole (dia 1.5)	1814521348
	connector 4 pole (dia 2.35)	1814521052
Ref.	Description	Part. No.
	Capacitors	
C171	47µF, 160V, electrolytic	2701741025
C172	10µF, 160V, electrolytic	2796331000
C173	470µF, 35V, electrolytic	2701741019
C174	470µF, 25V, electrolytic	2701741018
C175	10µF, 25V, electrolytic	2796141000
C301	47µF, 16V, electrolytic	2701741016
C302	47µF, 16V, electrolytic	2701741016
C303	47µF, 16V, electrolytic	2701741016
C311	100µF, 16V, electrolytic	2701741029
C312	0.010µF, 10%, 50V, ceramic	2508331038
C313	0.010µF, 10%, 50V, ceramic	2508331038
C314	47µF, 16V, electrolytic	2701741016
C315	0.010µF, 10%, 50V, ceramic	2508331038
C316	47µF, 16V, electrolytic	2701741016
C317	0.010µF, 10%, 50V, ceramic	2508331038
C318	47µF, 16V, electrolytic	2701741016
C319	10µF, 16V, electrolytic	2701741028
C320	0.0010µF, 10%, 50V, ceramic	2508281029
C321	0.022µF, 20%, 50V, ceramic	2508332238
C326	4.7µF, 25V, electrolytic	2701741020
C331	0.010µF, 10%, 50V, ceramic	2508331038
C332	0.010µF, 10%, 50V, ceramic	2508331038
C333	0.010µF, 10%, 50V, ceramic	2508331038
C334	0.010µF, 10%, 50V, ceramic	2508331038
C335	0.010µF, 10%, 50V, ceramic	2508331038
C336	0.010µF, 10%, 50V, ceramic	2508331038
C337	0.010µF, 10%, 50V, ceramic	2508331038
C338	2.2µF, 63V, electrolytic	2791202297
C341	2.2µF, 63V, electrolytic	2791202297
C343	2.2µF, 63V, electrolytic	2791202297
C352	0.010µF, 10%, 50V, ceramic	2508331038
C353	100µF, 16V, electrolytic	2701741029
C361	56pF, 5%, 50V, ceramic	2508415605
C362	82pF, 5%, 50V, ceramic	2509040815
C364	33pF, 5%, 50V, ceramic	2602320545
C365	33pF, 5%, 50V, ceramic	2602320545
C366	33pF, 5%, 50V, ceramic	2602320545
C367	5.1pF, 10%, 500V, ceramic	2509041403
C368	5.1pF, 10%, 500V, ceramic	2509041403
C369	5.1pF, 10%, 500V, ceramic	2509041403

## 9CM062/9CM082 REPLACEMENT PARTS LIST (Continued)

Ref.	Description	Part. No.	
<b>Resistors</b>			
(All are 5%, 0.2W metal film unless otherwise specified)			
R175	1kΩ, 0.33W	2302861022	R368 22kΩ, 0.33W 2302822235
R301	75Ω	2394027505	R369 1MΩ, 0.5W, 5% 2394041055
R302	75Ω	2394027505	R401 1kΩ, 0.33W 2302861022
R303	75Ω	2394027505	R402 470Ω, 0.33W 2302124715
R304	10kΩ	2394011035	R403 1kΩ, 0.33W 2302861022
R305	10kΩ	2394011035	R404 470Ω, 0.33W 2302124715
R306	10kΩ	2394011035	R406 1kΩ, 0.33W 2302861022
R307	10kΩ	2394011035	R407 120Ω, 1W, 5% 2394051215
R308	10kΩ	2394011035	R408 10kΩ, potm 2291070003
R309	10kΩ	2394011035	R409 10kΩ, 0.33W 2302821035
R311	330Ω	2302123315	R410 3.9kΩ, 0.33W 2302123922
R312	330Ω	2302123315	R411 5kΩ, potm 2204291273
R313	330Ω	2302123315	R412 22kΩ, 1% 2390990028
R314	22kΩ, 0.33W	2302822235	R413 1.5kΩ, 0.33W 2302890466
R315	82kΩ, 0.33W	2394038235	R415 1.3kΩ, 0.33W 2394041325
R317	15kΩ, 0.33W	2302821535	S R416 180Ω, 2W, 5% 2394061815
R318	15kΩ, 0.33W	2302821535	R417 2.2kΩ, 0.33W 2302122225
R319	9.1kΩ, 0.33W	2394049125	R418 13kΩ, 0.33W 2394031335
S R320	4.7Ω	2302684785	R419 2.2kΩ, potm 2204692222
R321	6.8kΩ, 0.33W	2302126825	R420 680Ω, 0.33W 2302126815
R322	10kΩ, potm	2291070004	R421 150kΩ, 0.33W 2394041545
R323	10kΩ, 0.33W	2302821035	R422 3.3kΩ, 0.33W 2302823325
R324	15kΩ, 0.33W	2302821535	R423 22kΩ, 0.33W 2302822235
R325	1kΩ, 0.33W	2302861022	R424 220Ω, 0.33W 2394262215
R326	15kΩ, 0.33W	2302821535	S R425 4.7Ω 2302684785
R327	1.2kΩ	2302041225	S R426 1kΩ, 2W, 5% 2394061025
R328	1kΩ, potm	2204291267	S R427 2.2Ω, 5W, 5% 2499090002
R329	1.2kΩ	2392041225	R428 68Ω, 0.5W 2302126805
R331	1.2kΩ	2392041225	S R429 2.2Ω, 5W, 5% 2499090002
R332	1kΩ, potm	2204291267	R431 2kΩ, 0.5W 2302122025
R333	1.2kΩ	2392041225	R432 2kΩ, 0.5W 2302122025
R334	1.2kΩ	2392041225	R433 100kΩ, 0.33W 2394041045
R335	1kΩ, potm	2204291267	R434 1kΩ, 0.5W 2394041025
R336	1.2kΩ	2392041225	R435 27kΩ, 0.33W 2302122735
R337	470kΩ, 0.33W	2302124745	R436 100kΩ, 0.33W 2394041045
R338	430Ω	2394024315	R347 1kΩ, 0.33W 2302861022
R339	82kΩ	2394028235	R348 1kΩ, 0.33W 2302861022
R341	430Ω	2394024315	S R439 1.5Ω 2302681585
R342	82kΩ	2394028235	R441 100Ω, potm 2291070002
R343	430Ω	2394024315	S R442 82Ω, 1W 2392058205
R344	82kΩ	2394028235	S R443 82Ω, 1W 2392058205
R345	10Ω	2394011005	S R445 100Ω 2302681015
R346	10Ω	2394011005	R446 120kΩ, 1% 2390990029
R347	10Ω	2394011005	R447 18kΩ, 1% 2390990030
R348	330Ω, 0.33W	2303203315	R448 4.3kΩ, 1% 2390990031
R349	330Ω, 0.33W	2303203315	R449 100Ω 2302121015
R351	330Ω, 0.33W	2303203315	R501 100kΩ, 0.33W 2394041045
S R352	4.7Ω	2302684785	R502 100kΩ, 0.33W 2394041045
R353	47Ω	2392044705	R503 10Ω, 0.33W 2303201005
R354	47Ω	2392044705	R504 5kΩ, potm 2203874722
R355	47Ω	2392044705	R505 4.7kΩ 2394044795
R356	22kΩ, 0.33W	2302822235	R506 4.3kΩ 2394024325
R357	56Ω	2394045605	R507 470kΩ, potm 2204291268
R358	56Ω	2394045605	R508 680kΩ 2394026845
R359	56Ω	2394045605	R509 470kΩ, potm 2204291268
R361	68Ω	2394026805	S R511 220kΩ 2302861273
R362	68Ω	2394026805	R512 150kΩ, 0.33W 2394041545
R364	33Ω	2392043305	R513 250kΩ, potm 2291010104
R365	33Ω	2392043305	R514 560kΩ, 0.33W 2302125645
R366	33Ω	2392043305	R516 100kΩ, potm 2204291269

## 9CM062/9CM082 REPLACEMENT PARTS LIST (Continued)

Ref.	Description	Part. No.	Ref.	Description	Part. No.			
<b>Resistors (continued)</b>								
	R517 56kΩ, 0.33W	2303205635		D326 diode	5301811001			
S	R518 2.2Ω	2302682285	D327 diode	5301811001				
	R519 4.7kΩ, 0.33W	2302124725	D353 diode	5301811001				
	R521 1.8kΩ, 0.33W	2302121825	D354 diode	5301811001				
	R522 150Ω, 1W	2302931515	D355 diode	5301811001				
	R524 10kΩ, potm	2291070003	D368 diode	5301811001				
	R525 3.9kΩ, 0.33W	2302123922	D407 zener diode 5.1V	5302390242				
	R526 150Ω, 1W	2302931515	D424 diode	5301811001				
	R528 2.2Ω, 0.33W	2392042295	D426 diode	5301711002				
	R529 330Ω, 0.5W	2303203315	D427 diode	5391500200				
	R531 4.7kΩ, 0.33W	2302124725	D431 diode	5302261002				
	R532 1.8kΩ, 0.33W	2302121825	D432 diode	5302390244				
	R533 120Ω, 0.33W	2302121215	D438 diode	5391510050				
S	R534 47kΩ, 0.33W	2302124735	D445 diode	5302681002				
	R535 10kΩ, 0.33W	2302821035	D447 zener diode 18V	5302250180				
	R536 2.2kΩ, 0.33W	2302122225	D505 diode	5301811001				
	R537 4.7kΩ, 0.33W	2302124725	D506 diode	5301811001				
	R538 15kΩ, 0.33W	2302821535	D519 diode	5301711002				
	R539 10kΩ, potm	2204291270	D528 diode	5301711002				
	R541 10kΩ, potm	2291010086	D534 diode	5301711002				
			D539 zener diode 2.4V	5390140249				
<b>Resistors</b>								
	R542 4.7kΩ, 0.33W	2302124725	D553 diode	5301711002				
	R543 270kΩ, 0.33W	2394032745	D554 diode	5302681002				
	R544 1.2kΩ, 0.33W	2302121225	D556 diode	5391500450				
	R545 100kΩ, 0.33W	2394041045	D557 zener diode 51V	5390255109				
	R546 1MΩ, 0.33W	2394041055	<b>Transistors</b>					
	R547 560kΩ, 0.33W	2302125645	TS311 NPN, driver	6103700001				
	R548 2.7kΩ, 0.33W	2302822725	TS312 NPN, driver	6103700001				
S	R549 2.7Ω	2302890464	TS313 NPN, driver	6103700001				
	R551 22kΩ, 0.33W	2302822235	TS317 PNP, driver	6103720002				
	R552 4.7kΩ, 0.33W	2302124725	TS345 NPN, driver	6190004470				
	R553 5.6kΩ, 0.5W	2302225625	TS346 NPN, driver	6190004470				
	R554 8.2kΩ, 0.5W	2302128225	TS347 NPN, driver	6190004470				
	R555 47kΩ, 0.33W	2302124735	TS353 NPN, output	6190102330				
S	R556 1.5Ω	2302681585	TS354 NPN, output	6190102330				
	R557 56kΩ, 0.33W	2302205635	TS355 NPN, output	6190102330				
	R558 47kΩ, potm	2291070006	TS356 NPN, driver	6104350002				
	R559 68kΩ, 0.33W	2302826835	TS425 NPN, driver	6105350003				
	R562 10MΩ, 0.33W	2302121065	TS428 NPN, output	6104400109				
	R563 4.7MΩ, 0.33W	2302124755	TS436 NPN, driver	6105000004				
S	R564 1.2Ω, 1W	2394051295	TS447 NPN, driver	6103700001				
	R566 1kΩ, 0.33W	2302861022	TS448 PNP, driver	610372C002				
	R567 47kΩ, potm	2291010048	TS501 NPN, driver	6104350002				
<b>Coils and transformers</b>								
	S319 coil 6.8μH	3618136899	TS502 NPN, driver	6104350002				
S	T401 hor. drive transf	3091000218	TS521 PNP, output	6190101480				
S	T402 line outp. transf	2290000032	TS524 NPN, output	6103680002				
	S427 coil 5μH	3618271774	TS536 PNP, driver	6190102320				
	S432 linearity coil	3691150001	TS537 PNP, driver	6190102320				
	S434 coil 200μH	3618271770	TS538 NPN, output	6104350002				
	S436 coil 12mH	3618271771	TS545 PNP, driver	6103720002				
			TS546 NPN, output	6190005570				
			TS551 NPN, output	6105350003				

## 9CM062/9CM082 REPLACEMENT PARTS LIST (Continued)

Ref.	Description	Part. No.	Ref.	Description	Part. No.			
<b>Integrated circuits</b>								
IC102	Voltage stabilizer	6192140331	R103	2.2Ω. 7W. 10%	2401440096			
IC301	RGB interface	6123300516	R104	10Ω. dual ptc	2302890465			
IC401	Exclusive OR	6123300517	R111	47kΩ. 0.33W	2302124735			
IC402	Multivibrator	6123300426	R112	47kΩ. 0.5W	2302124735			
IC403	Horizontal sync.	6123300518	R113	3kΩ. 0.5W	2303223025			
IC501	Vertical sync.	6123300423	R114	1kΩ. potm	2204291267			
<b>PARTS OF POWER SUPPLY</b>								
Ref.	Description	Part. No.	R115	4.3kΩ. 0.5W	2392044325			
<b>Miscellaneous</b>			R116	4.3kΩ. 0.5W	2392044325			
	Power supply complete	7044251878	R117	390Ω. 0.5W	2394163915			
	Power switch	1606780548	R119	9.1kΩ. 0.5W	2394049215			
	Power socket	1813930250	R121	110kΩ. 0.5W	2392041145			
	Connector 2 pole	1814521280	R122	120Ω. 0.33W	2302121215			
	Connector 5 pole	1814521053	R125	270Ω. 0.33W	2302122715			
S VL101	Fuse 3A/250V	1813900214	R126	18Ω. 0.33W	2392041895			
			R127	3.9kΩ. 0.33W	2302123922			
			R128	3.9kΩ. 0.33W	2302123922			
			S R129	30Ω. 1W	2394053005			
			R133	22kΩ. 5W	2302890472			
			R136	18Ω. 0.5W	2392041895			
			S R137	33Ω. 1W	2394053305			
			R146	100kΩ. 0.5W	2394041045			
			R152	1kΩ. 0.33W	2302861022			
Ref.	Description	Part. No.	Ref.	Description	Part. No.			
<b>Capacitors</b>								
S C102	0.22μF. 20%. 250V. polyester	2602320841	<b>Coils and transformers</b>					
S C103	0.0022μF. 125V. ceramic	2598230002	S T101	mains transformer	3091000269			
S C104	0.0022μF. 125V. ceramic	2598230002	S S102	line choke ac	3693400009			
C106	0.047μF. 20%. 400V. polyester	2509041325	S131	coil 10μH	3618271360			
C107	0.0022μF. 10%. 1KV. ceramic	2509041035	S136	coil 2μH	5699000032			
C108	0.0022μF. 10%. 1KV. ceramic	2509041035	S141	coil 180μH	3618271580			
C109	0.0022μF. 10%. 1KV. ceramic	2509041035	S142	coil 180μH	3618271580			
C110	0.0022μF. 10%. 1KV. ceramic	2509041035	S143	coil 100μH	3618271361			
C111	0.22μF. 10%. 250V. polyester	2602320543	S144	coil 100μH	3618271361			
C112	220μF. 200V. electrolytic	2701392220						
C116	47μF. 16V. electrolytic	2701741016						
C117	0.010μF. 20%. 50V. ceramic	2602320530						
C122	1μF. 50V. electrolytic	2701741015						
C124	0.013μF. 5%. 100V. polyester	2602320834						
C129	0.33μF. 10%. 63V. polyester	2508143349						
C132	0.0047μF. 10%. 630V. polyester	2509040712						
C133	0.047μF. 20%. 400V. polyester	2509041325						
C141	220pF. 10%. 500V. ceramic	2602320546						
C142	220pF. 10%. 500V. ceramic	2602320546						
C143	220pF. 10%. 500V. ceramic	2602320546						
C144	220pF. 10%. 500V. ceramic	2602320546						
C145	47μF. 160V. electrolytic	2701741025						
C146	100μF. 100V. electrolytic	2791261017						
C147	470μF. 35V. electrolytic	2701741019						
C148	470μF. 25V. electrolytic	2701741018						
C152	0.022μF. 5%. 400V. polyester	2509582239						

## 9CM062/9CM082 REPLACEMENT PARTS LIST (Continued)

Ref.	Description	Part. No.	Ref.	Description	Part. No.
Diodes		Capacitors			
D107	diode	5302551001	C701	0.010μF. 10%, 50V, ceramic	2508331038
D108	diode	5302551001	C702	47μF. 16V, electrolytic	2701741016
D109	diode	5302551001	C703	10μF. 160V, electrolytic	2796331000
D110	diode	5302551001	C705	0.010μF. 20%, 500V, ceramic	2509040919
D111	zener diode 24V	5302250240	C706	10μF. 160V, electrolytic	2796331000
D112	diode	5301811001	C707	0.010μF. 20%, 500V, ceramic	2509040919
D115	zener diode 6.2V	5301570629	C708	10μF. 160V, electrolytic	2796331000
D121	diode	5301811001	C709	0.010μF. 20%, 500V, ceramic	2509040919
D125	diode	5301811001	C711	10μF. 160V, electrolytic	2796331000
D126	diode	5301811001	C718	0.010μF. 20%, 500V, ceramic	2509040919
D127	diode	5301811001	C719	0.010μF. 20%, 500V, ceramic	2509040919
D128	zener diode 9.1V	5301990919	C720	0.010μF. 20%, 500V, ceramic	2509040919
D129	zener diode 2.4V	5390140249	C722	0.47μF. 10%, 100V, polyester	2508144749
D131	diode	5301811001	C726	470pF. 10%, 500V, ceramic	2602320845
D133	diode	5391500200	C728	0.47μF. 20%, 100V, polyester	2508144749
D136	diode	5391500200	C733	470pF. 10%, 500V, ceramic	2602320845
D137	diode	5391500430	C735	0.47μF. 20%, 100V, polyester	2508144749
D141	diode	5391500200	C739	470pF. 10%, 500V, ceramic	2602320845
D142	diode	5391500200	C741	0.010μF. 20%, 500V, ceramic	2509040919
D143	diode	5391500200	C742	22μF. 160V, electrolytic	2790332207
D144	diode	5391500200	C743	0.0022μF. 10%, 500V, ceramic	2598280004
D152	zener diode 16V	5390990690	C744	0.0022μF. 10%, 500V, ceramic	2598280004
D165	diode	5301811001	C745	0.0033μF. 500V, ceramic	2598280005
			C746	470pF. 10%, 2KV, ceramic	2602320547
			C751	39pF. 5%, 50V, ceramic	2509040928
			C752	39pF. 5%, 50V, ceramic	2509040928
			C753	39pF. 5%, 50V, ceramic	2509040928
Ref.	Description	Part. No.			
Transistors and Integrated Circuits					
IC101	Photo coupler	5392900120			
TS117	NPN. error latch	6105000004			
TS121	NPN. pulse width regulator	6190004040			
TS132	NPN. switch	6190005560			
TS152	Thyristor	6191400010			

## PARTS OF PICTURE TUBE PANEL

Ref.	Description	Part. No.
Miscellaneous		
	Picture tube panel complete	7092500210
	Connector 1 pole	1814521279
	Micro connector 8 pole	1814521282
	Connector 6 pole	1814521281
	CRT socket	5490400043
	Connector 1 pole	1814521445
S SG701	spark gap	1895000003
S SG702	spark gap	1895000003
S SG703	spark gap	1895000003

## 9CM062/9CM082 REPLACEMENT PARTS LIST (Continued)

Ref.	Description	Part. No.	Ref.	Description	Part. No.
<b>Resistors</b>					
(all are 5% metal film unless otherwise specified)					
R701	680Ω, 0.33W	2302126815	S706	coil 2.2μH	3618272028
S R702	2.2Ω	2302682285	S711	coil 2.2μH	3618272028
S R703	2.2Ω	2302682285	S715	coil 2.2μH	3618272028
S R704	2.2Ω	2302682285	S742	coil 7.5μH	3290000013
S R705	1kΩ, 3W	2394071025			
R707	10Ω, 0.2W	2394011005			
R708	33Ω, 0.2W	2392043305			
S R709	1kΩ, 3W	2394071025	<b>Coils</b>		
R712	10Ω, 0.2W	2394011005	S706	coil 2.2μH	3618272028
R713	33Ω, 0.2W	2392043305	S711	coil 2.2μH	3618272028
S R714	1kΩ, 3W	2394071025	S715	coil 2.2μH	3618272028
R716	10Ω, 0.2W	2394011005	D706	diode	5301811001
R717	43Ω, 0.2W	2394024305	D708	diode	5301711002
R722	220Ω, 0.5W	2394042215	D709	diode	5301711002
R723	330kΩ, 0.2W	2302123342	D711	diode	5301811001
R724	100kΩ, 0.2W	2394041045	D715	diode	5301811001
R725	22kΩ, 0.2W	2394042235	D722	diode	5302681002
R726	100kΩ, potm	2204291272	D723	diode	5302681002
R727	300kΩ, 0.2W	2302123042	D728	diode	5302681002
R728	220Ω, 0.5W	2394042215	D729	diode	5302681002
R729	330kΩ, 0.2W	2302123342	D735	diode	5302681002
R731	100kΩ, 0.2W	2394041045	D736	diode	5302681002
R732	22kΩ, 0.2W	2394042235	D742	diode	5302681002
R733	100kΩ, potm	2204291272			
R734	300kΩ, 0.2W	2302123042			
R735	220Ω, 0.5W	2394042215	<b>Diodes</b>		
R736	330kΩ, 0.2W	2302123342	D701	zener diode 8.2V	5302390245
R737	100kΩ, 0.2W	2394041045	D706	diode	5301811001
R738	22kΩ, 0.2W	2394042235	D708	diode	5301711002
R739	100kΩ, potm	2204291272	D709	diode	5301711002
R741	300kΩ, 0.2W	2302123042	D711	diode	5301811001
R742	1.5kΩ, 0.5W	2394041525	D715	diode	5302681002
R743	15kΩ, 0.5W	2394041535	D722	diode	5302681002
R751	8.2Ω, 0.5W	2392048295	D723	diode	5302681002
R752	8.2Ω, 0.5W	2392048295	D728	diode	5302681002
R753	8.2Ω, 0.5W	2392048295	D729	diode	5302681002
			D735	diode	5302681002
			D736	diode	5302681002
			D742	diode	5302681002
<b>Transistors</b>					
			TS705	NPN, output	6104150001
			TS706	PNP, output	5302390241
			TS707	PNP, driver	5302390253
			TS709	NPN, output	6104150001
			TS711	PNP, output	5302390241
			TS712	PNP, driver	5302390253
			TS714	NPN, output	6104150001
			TS715	PNP, output	5302390241
			TS716	PNP, driver	5302390253
			TS722	PNP, driver	5302390241
			TS735	PNP, driver	5302390241

**WARNING**

Critical components having special safety characteristics are identified with an S by the Ref. No. in the parts list and enclosed within a broken line\* along with the safety symbol ▲ on the schematics or exploded views.

Use of substitute replacement parts which do not have the same specified safety characteristics may create shock, fire, or other hazards.

Under no circumstances should the original design be modified or altered without written permission from the N.A.P. Consumer Electronics Corp. NAPCEC assumes no liability, express or implied, arising out of any unauthorized modification of design. Servicer assumes all liability.

\*Broken line: — • — • — • — •

# NAPCEC SAFETY GUIDELINES FOR THE PROFESSIONAL SERVICE TECHNICIAN

## Safety Checks

After the original service problem has been corrected, a complete safety check should be made. Be sure to check over the entire set, not just the areas where you have worked. Some previous servicer may have left an unsafe condition, which could be unknowingly passed on to your customer. Be sure to check all of the following:

## Fire and Shock Hazard

1. Be sure all components are positioned in such a way as to avoid the possibility of adjacent component shorts. This is especially important on those chassis which are transported to and from the service shop.
2. Never release a repaired receiver unless all protective devices such as insulators, barriers, covers, strain reliefs, and other hardware have been installed according to the original design.
3. Soldering and wiring must be inspected to locate possible cold solder joints, solder splashes, sharp solder points, frayed leads, pinched leads, or damaged insulation (including ac cord). Be certain to remove loose solder balls and all other loose foreign particles.
4. Check across-the-line components and other components for physical evidence of damage or deterioration and replace if necessary. Follow original layout, lead length and dress.
5. No lead or component should touch a receiving tube or a resistor rated at 1 watt or more. Lead tension around protruding metal surfaces or edges must be avoided.
6. Critical components having special safety characteristics are identified with an S by the Ref. No. in the parts list and enclosed within a broken line\* along with the safety symbol  on the schematics. Replacement parts without the same safety characteristics may create shock, fire or other hazards.
7. When servicing any receiver, always use a separate isolation transformer for the chassis. Failure to use a separate isolation transformer may expose you to possible shock hazard, and may cause damage to servicing instruments.
8. Many receivers use a polarized line cord (one wide pin on the plug). Defeating this safety

device may create a potential hazard to the servicer and the user. Extension cords which do not incorporate the polarizing feature should never be used.

9. After re-assembly of the set, always perform an ac leakage test or resistance test from the line cord to all exposed metal parts of the cabinet. Also, check all metal control shafts (with knobs removed), antenna terminals, handles, screws, etc. to be sure the set is safe to operate without danger of electrical shock.

\*Broken line: 

## Implosion

1. All picture tubes used in current model receivers are equipped with an integral implosion system. Care should always be used, and safety glasses worn, whenever handling any picture tube. Avoid scratching or otherwise damaging the picture tube during installation.
2. Use only replacement tubes as specified by the manufacturer.

## X-radiation

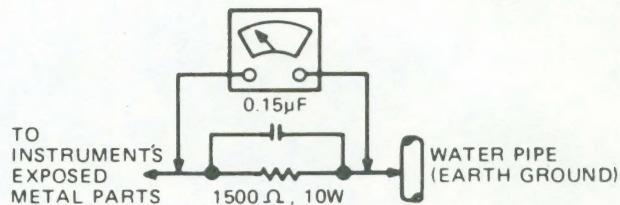
1. Be sure procedures and instructions to all your service personnel cover the subject of X-radiation. Potential sources of X-rays in TV receivers are the picture tube and the high voltage circuits. The basic precaution which must be exercised is to keep the HV at the factory recommended level.
2. To avoid possible exposure to X-radiation and electrical shock, only the manufacturer's specified anode connectors must be used.
3. It is essential that the service technician has available at all times an accurate HV meter. The calibration of this meter should be checked periodically against a reference standard.
4. When the HV circuitry is operating properly there is no possibility of an X-radiation problem. High voltage should always be kept at the manufacturer's rated value—no higher—for optimum performance. Every time a color set is serviced, the brightness should be run up and down while monitoring the HV with a meter to be certain that the HV does not exceed the

specified value and that it is regulated correctly. We suggest that you and your service technicians review test procedures so that HV and HV regulation are always checked as a standard servicing procedure, and the reason for this prudent routine be clearly understood by everyone. It is important to use an accurate and reliable HV meter. It is recommended that the HV reading be recorded on each customers' invoice, which will demonstrate a proper concern for the customers' safety.

- When troubleshooting and making test measurements in a receiver with a problem of excessive high voltage, reduce the line voltage by means of a Variac to bring the HV into acceptable limits while troubleshooting. Do not operate the chassis longer than necessary to locate the cause of the excessive HV.
- New type picture tubes are specifically designed to withstand higher operating voltages without creating undesirable X-radiation. It is strongly recommended that any shop test fixture which is to be used with the new higher voltage chassis be equipped with one of the new type tubes designed for this service. Addition of a permanently connected HV meter to the shop test fixture is advisable. The CRT types used in these new sets should never be replaced with any other types, as this may result in excessive X-radiation.
- It is essential to use the specified picture tube to avoid a possible X-radiation problem.
- Most TV receivers contain some type of emergency "Hold Down" circuit to prevent HV from rising to excessive levels in the presence of a failure mode. These various circuits should be understood by all technicians servicing them, especially since many hold down circuits are inoperative as long as the receiver performs normally.

#### Leakage Current Cold Check

- Unplug the ac line cord and connect a jumper between the two prongs of the plug.
- Turn on the power switch.
- Measure the resistance value between the jumpered ac plug and all exposed cabinet parts of the receiver, such as screw heads, antennas and control shafts. When the exposed metallic part has a return path to the chassis, the reading should be between 1 megohm and 5.2 megohms. When the exposed metal does not have a return path to the chassis, the reading must be infinity. Remove the jumper from the ac line cord.



#### Leakage Current Hot Check

- Do not use an isolation transformer for this test. Plug the completely re-assembled receiver directly into the ac outlet.
- Connect a 1.5k ohm, 10 watt resistor paralleled by a 0.15μF. capacitor between each exposed metallic cabinet part and a good earth ground such as a water pipe, as shown above.
- Use an ac voltmeter with at least 5000 ohms/volt sensitivity to measure the potential across the resistor.
- The potential at any point should not exceed 0.75 volts. A leakage current tester may be used to make this test; leakage current must not exceed 0.5 millamps. If a measurement is outside the limits specified, there is a possibility of shock hazard. The receiver should be repaired and re-checked before returning it to the customer.
- Repeat the above procedure with the ac plug reversed. (Note: An ac adapter is necessary when a polarized plug is used. Do not defeat the polarizing feature of the plug.)

#### Picture Tube Replacement

The primary source of X-radiation in this television is the picture tube. The picture tube utilized in this chassis is specially constructed to limit X-radiation emissions. For continued X-radiation protection, the replacement tube must be the same type as the original, including suffix letter, or an N.A.P. Consumer Electronics Corp. (NAPCEC) approved type.

#### Parts Replacement

Many electrical and mechanical parts in NAPCEC television sets have special safety-related characteristics. These characteristics are often not evident from visual inspection nor can the protection afforded by them necessarily be obtained by using replacement components rated for higher voltage, wattage, etc. The use of a substitute part which does not have the same safety characteristics as the NAPCEC recommended replacement part shown in this service manual may create shock, fire or other hazards.



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